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AI Breathes New Life into Respiratory Disease Diagnosis

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Artificial Intelligence (AI) has already integrated into conventional medical imaging and is now poised to revolutionise the diagnosis of respiratory diseases, which affect millions worldwide. These advancements include analysing chest scans, interpreting sound patterns, etc. thereby simplifying and improving the precision of diagnostic procedures. Let's delve into this in detail.

Respiratory diseases are major contributors to global mortality and disability. Chronic obstructive pulmonary disease (COPD) affects approximately 200 million people worldwide, causing 3.2 million deaths annually, ranking it third globally. Asthma impacts over 350 million individuals, predominately in childhood. Pneumonia claims over 2.4 million lives annually, with high mortality among young children and older adults. Tuberculosis (TB) affects over 10 million annually, resulting in 1.4 million deaths. Lung cancer leads to 1.8 million deaths annually. In 2019, respiratory diseases were among the top 10 global causes of death, claiming over 8 million lives, with South Asia experiencing the highest mortality from chronic respiratory conditions, according to reports from Forum of International Respiratory Societies.

Besides the top five respiratory diseases - COPD, asthma, acute lower respiratory tract infections, TB, and lung cancer, several other respiratory disorders carry significant burdens, including pulmonary hypertension, sleep-disordered breathing, and occupational lung diseases.

Majority of the patients with chronic respiratory conditions remain undiagnosed unfortunately. The current test for conditions like COPD and asthma is spirometry, an archaic technology that is difficult to access, unpleasant for patients, and frequently inaccurate. Also, many of these conditions present overlapping symptoms, making accurate diagnosis challenging and delaying timely treatment. Consequently, patient outcomes suffer while healthcare costs continue to rise. Early initiation of treatment is crucial for lung conditions like asthma and COPD, as effective management reduces symptoms and hospital visits, including emergency admissions. Premature mortality rates from these diseases are highest in regions with less-resourced health systems per capita.

AI, which has already made significant strides in diagnosing cancer and other diseases, also holds promise for revolutionising the speed and accuracy of respiratory disease diagnoses and presents a compelling solution to these issues. By leveraging

advanced algorithms, AI can streamline and enhance the precision of respiratory disease diagnosis.

Role of AI in Lung Disease Diagnosis

AI is transforming respiratory disease diagnosis by improving accuracy, streamlining workflows, and enhancing patient outcomes through faster and more precise diagnostics.

“AI and advanced technologies have immense potential to revolutionise lung-related health issues. These innovations analyse vast amounts of data with high precision, identifying patterns that streamline healthcare professionals' work, and extend their reach beyond the clinic, especially with remote patient monitors,” said **Adrian Ang, co-founder and CEO, Aevice Health, Singapore**.

Aevice Health is a digital health company dedicated to improving asthma and COPD care through its proprietary, non-invasive remote patient monitoring platform, the AeviceMD. The platform, powered by a wearable stethoscope, monitors key lung disease biomarkers at home, detecting early signs for timely intervention.

“AI-driven technologies also expedite the diagnostic process. Diagnosing diseases like asthma often involves observing patients' responses to medications, which are typically recounted during follow-ups and can be subjective. Devices like AeviceMD enable healthcare professionals to objectively track patients' responses to treatment, significantly speeding up the diagnostic process,” Adrian added.

AI is becoming pivotal in diagnosing challenging diseases like idiopathic pulmonary fibrosis (IPF), a potentially fatal lung condition causing scarring. Early diagnostic methods for IPF have been eagerly awaited by doctors, as there are currently no established therapies beyond drugs that can delay its progression. Due to the complexities in diagnosis, specialists are often consulted, and invasive techniques like lung biopsy pose risks of exacerbating the disease and increasing mortality.

A research group at Nagoya University has developed an AI algorithm that swiftly and accurately diagnoses IPF using non-invasive data from lung images and routine medical information. This advancement represents a significant step toward improving diagnostic precision and patient care in managing IPF.

AI-Powered Imaging Analysis

In pulmonary imaging, AI algorithms and machine learning techniques have shown promising results in automating image analysis, detecting abnormalities, and predicting disease prognosis.

Several firms have developed solutions utilising deep learning and AI to conduct real-time screening of medical images for radiologists and hospitals, with South Korea-based Lunit leading the way. Their Lunit FDA approved INSIGHT CXR is an AI-powered chest X-ray analysis solution capable of detecting 10 common lung abnormalities, including lung cancer and pneumonia. Lunit INSIGHT CXR has shown superior performance in multi-center studies, achieving the highest Area Under the Curve (AUC) and transforming global lung screening practices in markets such as Singapore, Saudi Arabia, Taiwan, and France.

Australian medical imaging AI company Annalise.ai has developed Annalise CXR, its flagship AI solution for interpreting chest x-ray studies. This comprehensive tool detects 124 findings, providing clinicians with additional diagnostic support and assurance. Annalise CXR is currently available for clinical use across Australia, New Zealand, the EU, the UK, India, ASEAN, the UAE, and expanding further. Meanwhile, 4DMedical, another Australian innovator, is pioneering non-invasive, quantitative analysis of lung function through their software and hardware products. Their technology sets a new standard in imaging and analysis for lung disorders such as unexplained dyspnea, asthma, COPD, cystic fibrosis, and cancer, advancing diagnostic capabilities and treatment outcomes.

India-based Qure.ai, which in June 2024 received investment from Merck Global Health Innovation Fund, provides FDA-approved solutions for diagnosing lung-related diseases. Their flagship product, qXR, employs AI to interpret chest X-rays, enabling the identification of lung cancer and other conditions with accuracy. Qure.ai also offers qTrack, an AI-powered platform designed for tuberculosis care management. This platform supports screening programmes and enhances case management through advanced technological solutions, contributing significantly to improved healthcare outcomes in respiratory health. Another Indian startup Dectrocel Healthcare has developed a platform in which digital and analogue chest X-Ray images and pictures of children are uploaded and, in a few minutes, the algorithm is able to diagnose respiratory abnormalities.

“In lung disease we have lung function tests, CT scans, blood biomarkers, breathing monitors, all sorts of data to work with. And we have multi-year delays in diagnosis common in lung diseases! AI helps both with depth and breadth here, better analysing the tiny minutiae in these data elements, but also combining them in ways that are otherwise irrelevant. This means we can both do a better job diagnosing patients and doing it consistently and effectively,” said **Dr Josh Reicher, co-founder and CEO of IMVARIA, USA**.

IMVARIA focuses on improving diagnosis across a wide range of use cases, beginning with lung-related diseases. Their first product focuses specifically on lung fibrosis, a serious and often underdiagnosed condition that can be fatal if untreated, with an average diagnostic delay of 2.2 years. Named Fibresolve, it offers AI-based analysis of lung CT scans to enhance non-invasive diagnosis. Fibresolve received FDA De Novo marketing authorisation in 2024.

Diagnosis through sound

Cough is an early symptom associated with various pulmonary diseases and serves as a marker for tracking the progression of respiratory conditions and infections. Since COVID-19, there has been heightened interest in analysing cough patterns to differentiate between COVID-19 and other types of coughs. Machine Learning (ML) algorithms enable AI systems to learn and recognise distinctive patterns in lung sounds, aiding in the early detection and diagnosis of specific diseases.

The Australian company ResApp Health has been working on acoustic diagnosis of respiratory diseases since 2014, well before the pandemic. With the emergence of COVID-19, the company shifted its focus and developed an audio-based COVID-19 screening test. By 2022, the tool successfully identified 92 per cent of positive COVID-19 cases solely from the sound of a patient's cough. Shortly thereafter, Pfizer acquired the firm for $116 million.

Indian firm Salcit Technologies has developed Swaasa, an AI-powered software that analyses cough sounds for assessing lung health. Swaasa has received a no-objection certificate from the Central Drugs Standard Control Organisation (CDSCO) and holds patents in India, the US, Australia, and other countries.

Korean researchers have also developed a new machine learning (ML) algorithm that detects pneumonia by analysing cough recordings and room acoustics. This algorithm can diagnose respiratory diseases both in hospitals and at home.

ML for predictive analytics

Researchers are working on developing tools capable of detecting early signs of diseases years before doctors can diagnose them. A researcher from the University of Texas at Dallas, along with international colleagues, has developed an algorithm that could potentially provide early medical alerts for the onset of asthma attacks or other respiratory problems in the future.

Researchers from the University of Canterbury, New Zealand have developed a tool known as Breath-to-Breath Observed Biometrics, or BOB, to help prevent respiratory illnesses. With BOB, more frequent monitoring can be as simple as breathing normally into the device each morning. They have developed research specialised software to interpret and transmit these results to GP, enabling data-driven care that exceeds the capabilities of appointments every one to three months. This software can automate diagnosis and frequent patient monitoring, reducing the strain on scarce clinician time.

Singapore-based Aevice Health, is partnering with London-based Jiva.ai, to develop a remote patient monitoring platform that will allow people living with asthma to track their condition and predict asthma attacks.

“In general the predictive capabilities of AI open up new possibilities in respiratory care,” **says Ameera Patel, CEO TidalSense, UK**. TidalSense is developing AI-based diagnostic and monitoring solutions for COPD and asthma. These solutions utilise patented sensor technology to detect changes in the lungs, enabling automatic and more accurate diagnosis of respiratory conditions.

Ameera further said, “In the future we could forecast future disease development, guiding clinical decisions and enabling early interventions. Very soon AI could identify individuals within populations who are at highest risk of developing chronic respiratory diseases, such as COPD, allowing for targeted preventive diagnosis. This could ensure faster access to appropriate treatments and medications, which is critical for improving outcomes in respiratory conditions.”

“While AI shows great promise, it's important to note some challenges,” says **Brandon Suh, CEO, Lunit, South Korea** . He said, "The need for large, diverse datasets to train AI models effectively, ensuring AI algorithms work consistently across different populations and healthcare settings, and maintaining patient privacy and data security are some of the challenges."

In addition, there are also concerns that AI might replace specialists. Experts however foresee AI providing physicians with insights they couldn't previously obtain and becoming a vital tool for enhancing diagnoses.

“We've seen a lot of sensationalistic headlines about 'replacing doctors' or such things. On the other hand, sceptics see it all as snakeoil. The reality is somewhat different. AI is most valuable as a complement, as a tool completing tasks that add new value into the process,” concludes Dr Reicher.

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